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Operating Manual
For
ASHIDA Numerical Transformer Differential Relay
TYPE: ADR 133A
ADR 233A (With Communication Port)

REV	DESCRIPTION	DATE	CHK. BY	APPD. BY
03B	Operating Manual For Ashida Numerical Transformer Differential Relay **ADR 133A**	08.10.09	Vandana	SMK

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1.0 Features

- Online display of Phase Current / Differential Current.
- Latching of fault current value.
- High Speed operation 30ms at 5 times
- Operation base on fundamental frequency value.
- Harmonics restrain for Transformer charging and CT saturation condition.
- Cross harmonics restrain, the relay will restrain all 3 Phases even if harmonic detected in any one phase.
- Programmable starting current.
- Programmable Internal ICT (interposing CT) ratio to match different transformer having different vector groups
- Programmable dual bias setting
- Wide setting range 10-50% for bias in steps of 5%
- Programmable 2nd HRM restrain 10% - 80%
- **Can be upgraded to ADR233A having disturbance record and 100 Event**

2.0 Application

- Two winding power transformers
- Auto transformers
- Biased differential protection for generators

3.0 General

ADR133A is member of Ashida Numerical Relay family (Aditya Series) designed to meet demand of low and medium transformer protection requirement. It consists of all the basic function need to protection of transformer such as harmonic restrain, dual bias differential protection.

The ADR133A is designed using high-speed micro DSP, which sample all three-phase current through CT connection. The high-speed micro-controller **samples** this current through a **12-bit A/D converter**.

The micro-controller performs powerful **Digital Algorithms** to find out Amplitude of current signal, then this value is use for protection and metering

function. All measurement is tuned to fundamental frequency. Each input current is also displayed on 20 x 4 LCD display for metering.

4.0 Protection Functions

The ADR133A give maximum benefit/cost ratio. The ADR133A give all the advantage of numerical relay at affordable cost. Following is summery of different protection functions provided by relay.

ANSI	*IEC*	*Protection Functions*
87	-	Dual Bias Differential Protection
87HS	-	Instantaneous Differential High Set

This relay is provided with Triple slop characteristics for Protection i.e.

1. Zero Bias Slop
2. Differential Bias Slop
3. 2nd Bias Slop

4.1 Zero Bias Slop

This is the value of current expressed as percentage of chosen current rating at which the relay will operate with zero bias current.

Setting range

Pickup range is from 10% to 100% in steps of 5%.

4.2 Differential Bias Slop

Whenever there is difference in current in LV and HV side of Transformer the current will increase with increasing load or through fault current in the transformer. To maintain stability the bias current must increase proportionally keep bias setting greater than the maximum predictable percentage difference current.

Setting Range

Bias range is from 10% to 50% in steps of 5%.

4.3 2nd Bias Slop

2nd Bias Slop gives more stability during CT saturation for heavy through fault this setting is expressed in multiple of normal rated LV current. The 2nd bias is fix to 80%. The bias current at which relay switch to 2nd bias slope is programmable.

Setting Range

The bias current value at which relay shift to 2nd Bias from 100% to 400% in steps of 100%.

4.4 Instantaneous Differential High Set Protection

The relay is provide with differential high set protection where $|IH - IL|$ is greater than a preset value, relay will provide high set protection HF should be set as low as possible but not less than the maximum three phase through fault current and not less than the maximum magnetizing current.

Setting Range

HF range is from 100% to 2000% in steps of 100%. 0 is equal to Bypass.

5.0 Communication Section

The ADR233A has two communication Ports, RS232 on Front and RS485 at Rear. The unit uses IEC870-5-103 Communication Protocol.

6.0 Supervision Function

6.1 Self-supervision

The relay continuously keeps track on its internal hardware and software and the movement it detect any failure of any component, it give message on LCD display as error code details of error code available in User's manual and also having dedicated potential free contact for external ALARM. This feature is very useful to give pre information to avoid any mall - operation. In such situation it use some default setting and remain in protection mode.

7.0 Working Principle and Design

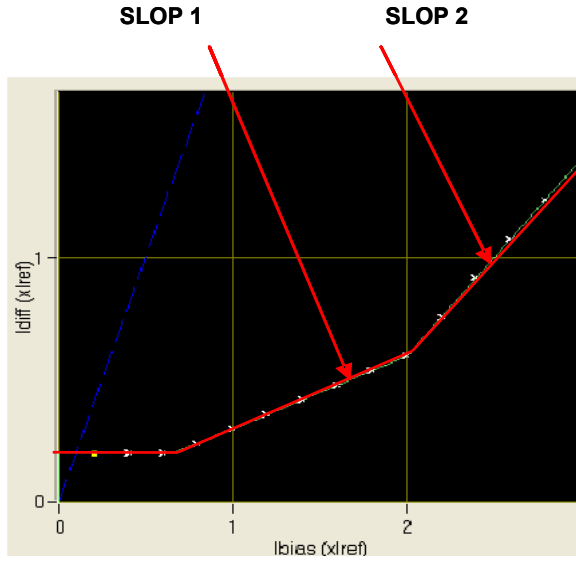
The ADR133A monitor HV and LV current of power transformer through respective CT. The sample current values are processed by power fully DSP controller. It convert these current samples in to equivalent vectors and numbers of parameter such as RMS values of IHV and ILV and phases. IHV represent HV current and ILV represent LV current. Normally to match HV and LV CT ratio, phase shift between two winding due to transformer vector group, ICTs (interposing CTs) are needed. In ADR133A ICTs are software selectable. There are two separate ICT ratio and vector groups are provided, one for HV value and another for LV value. After applying this corrective factor, relay calculate operating and restring signal from IHx and ILx (IH1 and IL1 is HV and LV current after applying ICT correction factor. x denote phase, 1 for R, 2 for Y and 3 for B). Base on this and setting relay decide to operate or restrain.

Operating Current
Iox = IHx – ILx

Restraining Current
Ibx = (|IHx| +| ILx|) / 2

Relay operate when Io is greater than pick-up current setting and
Iox > = S Ibx
Where S = set bias. (Slope 1)

The relay support dual bias characteristic. The bias (slop 1) is settable from 10% to 50% This is a normal bias characteristic. The relay follows this characteristic up to Ibx become equal to 2nd Bias I setting. During heavy through fault due to CT saturation large difference current might generate, which lead to mal operation of relay. To prevent mal operation during such heavy through fault relay is provided with dual bias characteristic. In which after 2nd Bias I setting the relay change it bias setting from set value to 80% automatically.



The relay is provided with differential highest protection where |IHx-ILx| is greater than a preset value relay will provided high-set protection. High-set setting can be bypassed when it is not required. The relay detect transformer charging condition from 2nd harmonics contents. If 2nd harmonics are more than set limit then relay block tripping operation. Similarly relay detect over excitation condition from 5th harmonics and restrain it operation.

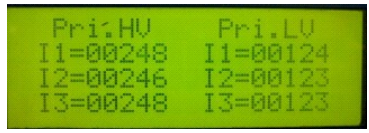
Most of the relays are multifunction and having large numbers of setting. The ADR series relay having big 4 line 20 character back lit LCD display and very strong user interface, this make very easy to manage the relay setting.

All setting are arranged in menus for easy understanding of parameter

Maximum settings in one display

The relay shows all the parameters such current before ICT current after ICT, Primary current , Bias and difference current.

Similarly relay latches fault current, type fault with date and time stamp**. If relay is upgrade to communication the it can provide full disturbance record in COMTRADE format for details analysis.**



7.1 Interposing CT Multiplier (HV and LV Side)

This range of settings enable the effective ratio of the HV & LV CT's to be adjusted.

Setting Range:

IHM & ILM – 0.50 to 2.50 in steps of 0.01

HV Interposing CT Connection

An equivalent interposing CT connection can be selected from this range of settings. The settings define the LV and HV winding configuration.

E.g. Yd, followed by the angular position of the LV phase or with respect to the HV phase or. The angular position is described by the hour – hand position on the twelve-hour clock face, e.g. Yd1 or Yd11. In each setting, this is followed by the same angular relationship expressed in degrees. The complete Yd1 setting will therefore read Yd1, -30° and Yd11 will read Yd11, 30°.

Setting Range:

VGHV – Yy0, Yy2, Yy4, Yy6, Yy8, Yy10, Yd1, Yd3, Yd5, Yd7, Yd9, Yd11, Ydy0 and Ydy6

LV Interposing CT Connection

As the HV connection but now applied to the LV CT's.

Setting Range:

VGVL – Yy0, Yy2, Yy4, Yy6, Yy8, Yy10, Yd1, Yd3, Yd5, Yd7, Yd9, Yd11, Ydy0 and Ydy6

Interposing CT Selection Guide

Power Transformer Vector Group	HV Interposing CT Selection	LV Interposing CT Selection
Yy0, Yny0, Yyn0, Ynyn0, Ydy0, Yndy0, Ydyn0, Yndyn0	Yd1,30°	Yd1,30°
Yd1, Ynd1	Yd1,30°	Yy0,0°
Yd1, Ynd1 + Earthing Transformer	Yd1,30°	Ydy0,0°
Yy2, Yny2, Yyn2, Ynyn2, Ydy2, Yndy2, Ydyn2, Yndyn2	Yd3,90°	Yd1,30°
Yd3, Ynd3	Yd3,90°	Yy0,0°
Yd3, Ynd3 + Earthing Transformer	Yd3,90°	Ydy0,0°
Yy4, Yny4, Yyn4, Ynyn4, Ydy4, Yndy4, Ydyn4, Yndyn4	Yd5,150°	Yd1,30°
Yd5, Ynd5	Yd5,150°	Yy0,0°

Yd5, Ynd5 + Earthing Transformer	Yd5,150°	Ydy0,0°
Yy6, Yny6, Yyn6, Ynyn6, Ydy6, Yndy6, Ydyn6, Yndyn6	Yd7,-150°	Yd1,30°
Yd7, Ynd7	Yd7,-150°	Yy0,0°
Yd7, Ynd7 + Earthing Transformer	Yd7,-150°	Ydy0,0°
Yy8, Yny8, Yyn8, Ynyn8, Ydy8, Yndy8, Ydyn8, Yndyn8	Yd9,-90°	Yd1,30°
Yd9, Ynd9	Yd9,-90°	Yy0,0°
Yd9, Ynd9 + Earthing Transformer	Yd9,-90°	Ydy0,0°
Yy10, Yny10, Yyn10, Ynyn10, Ydy10,Yndy10, Ydyn10, Yndyn10	Yd11,-30°	Yd1,30°
Yd11, Ynd11	Yd11,-30°	Yy0,0°
Yd11, Ynd11 + Earthing Transformer	Yd11,-30°	Ydy0,0°
Dy1, Dyn1	Ydy0,0°	Yd11,-30°
Dy1, Dyn1 + Earthing Transformer	Ydy0,0°	Yd11,-30°
Dy3, Dyn3	Ydy0,0°	Yd9,-90°
Dy3, Dyn3 + Earthing Transformer	Ydy0,0°	Yd9,-90°
Dy5, Dyn5	Ydy0,0°	Yd7,-150°
Dy5, Dyn5 + Earthing Transformer	Ydy0,0°	Yd7,-150°
Dy7, Dyn7	Ydy0,0°	Yd5,150°
Dy7, Dyn7 + Earthing Transformer	Ydy0,0°	Yd5,150°
Dy9, Dyn9	Ydy0,0°	Yd3,90°
Dy9, Dyn9 + Earthing Transformer	Ydy0,0°	Yd3,90°
Dy11, Dyn11	Ydy0,0°	Yd1,30°
Dy11, Dyn11 + Earthing Transformer	Ydy0,0°	Yd1,30°

Notes:

1. Y or y denotes an unearthed star connection on the HV or LV side of the transformer respectively.
2. YN or yn denotes an earthed star connection on the HV or LV side of the transformer respectively.
3. D or d denotes a delta connection on the HV or LV side of the transformer respectively.

8.0 Current Transformer requirement

For high speed operation under all fault conditions the minimum current transformer knee point voltage should equal or exceed $Vt \geq 4 * IF (A + C)$

Where

IF = Either the maximum three phase through fault current (as limited by the Tx impedance) or the highset setting, whichever is greater.

A = the secondary winding resistance of each star connected CT

C = The CT Secondary loop lead resistance for internal earth faults.

9.0 Typical Relay Setting Calculation

Power Transformer Details:

Voltage	= 132 / 33KV
Rating	= 60MVA
Tap Changer	= +5% - 15%
Vector Group	= Yd1

Current Transformer Details:

CT Ratio	
For HV Side	= 300/1
For LV Side	= 1200/1

Calculation:

HV rated current	= 60MVA / (132 * 1.732) = 262.4A.
CT ratio for HV side is 300/1	
LV rated current	= 60MVA / (33* 1.732) = 1049.76A
CT ratio for LV side is 1200/1	
Mean tap value	= [(+5) + (-15)] / 2 = -5%
HV current at –5% tap	= (60MVA) / (1.732 * 132KV *0.95) = 276.2A
HV Multiplier	= 300 / 276.2 = 1.086 = 1.09
LV CT secondary current	= 1049.7 / 1200 = 0.87475A
So the LV multiplier	= 1200 / 1049.7 = 1.143 = 1.14
Initial Setting	= 200mA (20%) or2 times of maximum spill current which ever is greater.
Bias setting	= 20% 2 times of maximum tap change %
Bias Slope Limit	= 4 times of full load current
HV ICT vector connection	= Yd1, 30
LV ICT vector connection	= Yy0, 0
HV ICT multiplier	= 1.09
LV ICT multiplier	= 1.14

Relay Setting Name	Description	Settings
Unit ID	Use for Communication of RS232 & RS485	1
Pickup	It is initial Difference Current between HV & LV side	20%
Bias	It allows operative Current to increase automatically to the extend it is required. (Due to CT mismatch)	20%
2nd Bias I	This characteristatis is with Slop2 (S2) it is fixed i.e. 80%	400%
HF	It is Differential Highset it is not restrained by the magnetic inrush detector	1200
CT Secondary	Represents secondary current ratio of CT. the same relay is suitable for 1A & 5A	1A
IHM	It is HV ICT multiplier	1.09
ILM	It is LV ICT Multiplier	1.14
Trip Test	To check online testing of Relay	No
VGHV	It is HV ICT Vector Connection	Yd1,30
VGLV	It is LV ICT Vector Connection	Yy0,0

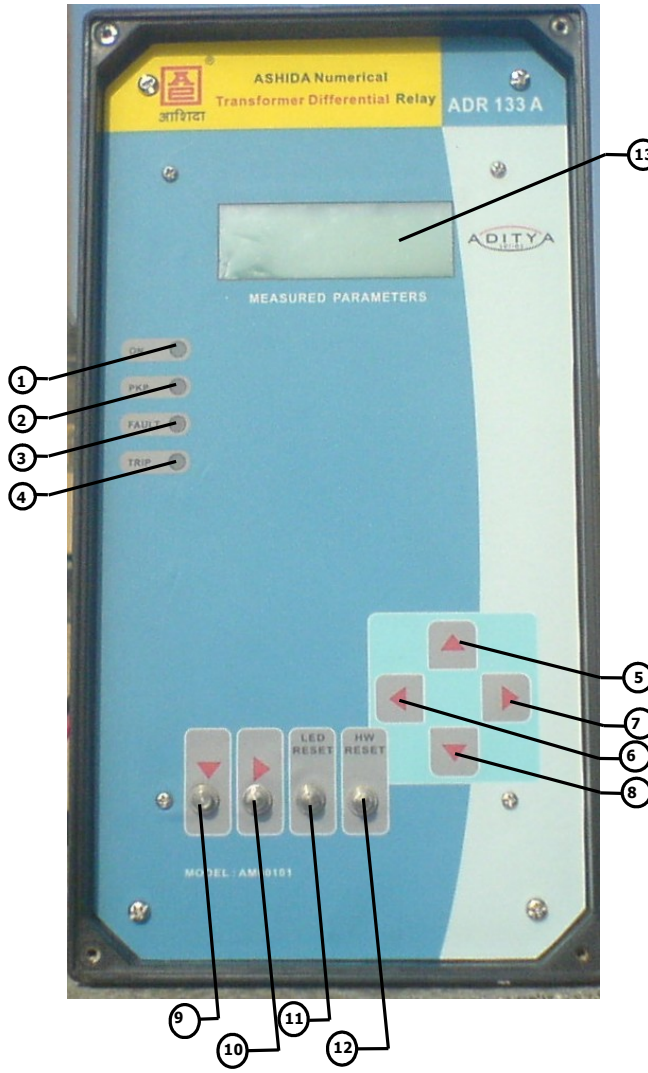
10.0 Electrical Noise Immunity

Utility and industrial environments are electrically very noisy. Electronics protection equipment requires careful design and testing to ensure reliable operation in switchgear. Ashida has applied its expertise and more than 35 years of experience in field of electronics design to ensure that the ADR 133A operates when required, without nuisance trips. Thanks to the latest micro-controller technology.

11.0 Setting Reliability

Any numerical or digital relay in which all settings are programmable via keyboard or communication port, use some internal memory to store these settings. Many relays use internal rechargeable batteries to maintain these settings. In case of power supply fluctuation, batteries are often unreliable, and settings get corrupted. In such situation, the relay may mal-operate. Ashida uses special non-volatile memory technology, which does not require any power source to maintain settings of the relay. Once the relay is programmed, it maintains the settings more than 10 years even in the absence of any power supply. In case if internal fault is detected in this section during the self diagnosis, then relay gives message and take default settings stored in program memory to avoid any mal-operation.

12.0 Front Panel and Control



No	Legend	Function
1	ON	Power 'ON' indicator LED.
2	PKP	Relay 'Pick-up' indicator LED.
3	FAULT	'Fault' Indicator (HR) Type LED.
4	TRIP	'Trip' indicator (SR) Type LED.
5	▲	Feather Touch Up arrow key (▲) used to Scroll the Main Menu and to increment the values in setting mode
6	◄	Feather Touch Left arrow key (◄) used to select settings
7	►	Feather Touch Right arrow key (►) used to view the settings.
8	▼	Feather Touch Down arrow key (▼) used to Scroll the Main Menu and to decrement the values in setting mode.
9	▼	Push button (▼) used to Scroll the Main Menu
10	►	Push button (►) to view the settings.
11	LED RESET	Push button to Reset the LEDs.
12	HW RESET	Push button to Reset Hardware of the relay.
13	LCD Display	All the settings, the measuring values as well as the Fault data is shown LCD display 20 x 4 char.

Keys and Push Buttons

The function of relay is controlled by the following keys, Left Arrow key (◄), Right Arrow key (►), Up Arrow key (▲) Down Arrow key (▼) and push buttons which are provided on the front Plate.

The relay has a front cover to keep it dust free. For easy access to the operator to operate the push button marked as (▼) is used to scroll display and is parallel with Down arrow key (▼). The push button marked as (►) is parallel with right arrow key (►) to view the settings. The push button marked as HW Reset is used to reset the hard ware.

- When the Right Arrow key (►) is pressed the operator is able to view the setting of the relay. When the Right Arrow key (►) is pressed again it will go to the next setting, but in case there are no more setting to be displayed it returns to the main menu.
- When the Left Arrow key (◄) is pressed you are able to enter the setting which can be now modified using Up Arrow key (▲) Down Arrow key (▼). When the Left Arrow key (◄) pressed again it will go to the next setting.
- The Up Arrow key (▲) is used to increment the value, the Down Arrow key (▼) is used to decrement the value in the display.
- The Left Arrow key (◄) Right Arrow key (►) can be used to go forward or backward, both when doing the settings and while viewing the settings

At the time of setting if changes are not carried within 100s then the display will reset it self and return to the main menu.

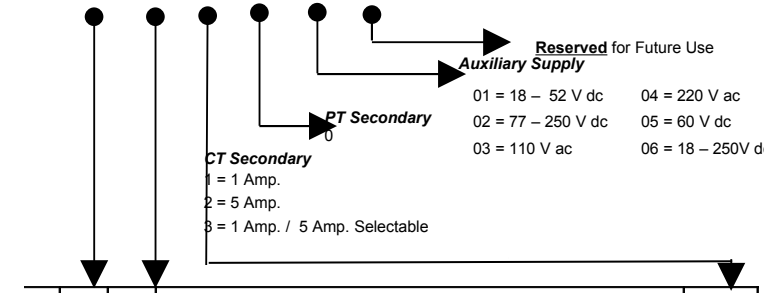
12.1 Ordering Information

The relay is available with nos. of different option. The option is specified by model no. It is user responsibility to specify correct model no. while ordering.

While Ordering Specify the following Information for **ADR133A** Relay

Definition of Model No of Aditya Series of Relays

AM XXX–XX – X – X – XX – X



AM	XXX	XX			X
			Transformer Differential Relay		
	001	01	Relay without Fix CT. Compatible with ACDF31F	CSD – 150V	1 / 2
		02	Relay without Fix CT. Compatible with ACDF31F with Extra NO Contact	CSD – 150V	1 / 2
		03	Reserved		
		04	Relay with Selectable CT and Drawout Cabinet	CSD – 150VD	3
	001	05	Relay with selectable CT, non draw-out Cabinet with (1) one extra contact and wide setting range	CSD-V-120	3
	002	05	Relay with selectable CT, non draw-out Cabinet with (3) Three extra contact and wide setting range	CSD-V-120	3

Ordering information:

A	D	R	1	3	3	A	-	A	M	-	X	X	X	-	X	X	-	X	+	X	-	X	X	-	X

Example

ADR131A – AM-002-05-3-0-02-0

Type : ADR133A with wide setting, draw out case and extra contacts.

Auxiliary Supply : 77-250Vdc

CT Sec. : 1/5Amp

13.0 Getting Started : -

After Power ON, or when the HW (Hardware) RESET push button is pressed the relay will display the following message. (BURADAYIM)

```
Ashida Numerical
Tx Diff. Relay
ADR133A V4.13-o
Unit ID = 0001
```

What is displayed is as follows
Relay Name – Ashida Numerical Transformer Differential Relay,
Relay Type – ADR133A, Software Revision No – V4.13-o
and Unit ID = 0001.

Here in ASHIDA we believe in continuous improvement. Whenever we do any relay firmware modification it is recorded as version change. The relay has the facility to upgrade firmware at site, so that customer can be benefited with latest modification.

```
With Scaling
IH1= 00.00 IL1 = 00.00
IH2= 00.00 IL2 = 00.00
IH3= 00.00 IL3 = 00.00
```

The above window is a default window showing the online current with scaling.

(Note: If the left arrow key (◂) is pressed the display will go to **Main menu** directly skipping the Difference Current, Without Scaling and Primary HV & LV windows)

When the Right Arrow key (▸) is pressed then relay will show Difference Current.

```
 Diff I        Bias I
I1D = 00.00   I1B = 00.00
I2D = 00.00   I2B = 00.00
I3D = 00.00   I3B = 00.00
```

When the Right Arrow key (▸) is pressed then relay will show on line current without scaling.

Without Scaling
IH1= 00.00 IL1 = 00.00
IH2= 00.00 IL2 = 00.00
IH3= 00.00 IL3 = 00.00

When the Right Arrow key (▸) is pressed then relay will show on line current Primary HV and Primary LV.

Pri. HV	Pri. LV
RH= 00000	RL = 00000
YH= 00000	YL = 00000
BH= 00000	BL = 00000

When the Right Arrow key (▸) is pressed then relay will now displays the **Main Menu** as follows.

Date & Time
→ **Measurement** ←
Settings
Fault 1
Fault 2
Fault 3
Fault 4
Fault 5
Relay Test
Error Log
Status
Date Time

Date & Time, Measurement, Settings, Fault 1, Fault 2, Fault 3, Fault 4, Fault 5, Relay Test, Error Log and Status are the various options available in **Main Menu** of this relay.

Since the LCD Display consist only of 4 Lines, the main menu list can be scrolled up or down by using the Up Arrow key (▴) or the Down Arrow key (▾). The arrow pointers in the display will jump from option to option.

14.0 To Adjust Date Time Settings

After **Power ON**, or when the HW (Hardware) RESET push button is pressed the relay will display the following message.

```
Ashida Numerical
Tx Diff. Relay
ADR133A V4.13-o
Unit ID = 0001
```

```
With Scaling
IH1= 00.00 IL1 = 00.00
IH2= 00.00 IL2 = 00.00
IH3= 00.00 IL3 = 00.00
```

Press the left arrow key (◂) the display will go to Main menu

```
→ Date & Time ←
   Measurement
     Setting
      Fault 1
```

By using the up arrow key (▴) or down arrow key (▾) move the arrow pointers in the display to select the **Date & Time** in the main menu. Now when the Left Arrow key (◂) is pressed then the following message is displayed.

```
Password = 001
 Use INR/DEC
```

14.1 Setting Password

By using the up arrow key (▴) or the down arrow key (▾) enter correct **Password**.

When Up Arrow key (▴) is pressed, it will start to increment the password setting by 1 i.e. now display will show.

```
Password = 001
Use Inr/Dec
```

If the Up Arrow key (▴) is held in pressed condition for more than 4 seconds the selected value will start incrementing with high speed.

Case :

For example if required value to be set is 025. Hold the Up Arrow key (▴) in pressed condition till you get the reading at 020, then releases the Up Arrow key (▴) and increment one by one to set the required value. Similarly this can be done also by using the Down arrow key (▾).

When the Up Arrow key (▲) is held in pressed condition, then the display value will start incrementing with high speed and roll between min. & max. The min. is 0 and max. is 99.

When Down Arrow key (▼) is held in pressed condition then the display value will start decrementing with high speed and roll between max. & min. The max. is 99 and min. is 0.

When the entered password matches with the previously set password only then we will be able to change the settings. But if the password entered is wrong, then the following Error message will be displayed.

```
Password Fail
```

And control will automatically returned to main menu

But by using the up arrow key (▲) or the down arrow key (▼) when the **Password** is set so as to match the previously set password.

Then when the left arrow (◄) is pressed again the following message will be displayed.

```
SET Hrs = 0011
Range 0-23
```

14.2 Setting Hours

By using the up arrow key (▲) or the down arrow key (▼) the desired **Hour** can be set. The range will be form 0 hour to 23 hours.

Then when the left arrow key (◄) is pressed again the following message will be displayed.

```
SET Mins = 0005
Range 0-59
```

14.3 Setting Minutes

By using the up arrow key (▲) or the down arrow key (▼) the desired **Minutes** can be set. The range will be from 0 minute to 59 minutes.

Then when the left arrow key (◄) is pressed again the following message will be displayed.

```
SET Sec = 0030
Range 0-59
```

14.4 Setting Seconds

By using the up arrow key (▲) or the down arrow key (▼) the desired **Seconds** can be set. The range will be from 0 second to 59 seconds.

Then when the left arrow key (◂) is pressed again the following message will be displayed.

```
SET Date = 0020
Range 1 - 31
```

14.5 Setting Date

By using the up arrow key (▴) or the down arrow key (▾) the desired **Date** can be set. The range will be from 1 to 31.

Then when the left arrow key (◂) is pressed again the following message will be displayed.

```
SET Month = 0003
Range 1 - 12
```

14.6 Setting Month

By using the up arrow key (▴) or the down arrow key (▾) the desired **Month** can be set. The range will be from 1 to 12.

Then when the left arrow (◂) is pressed again the following message will be displayed.

```
SET Year = 0009
Range 00-99
```

14.7 Setting Year

By using the up arrow key (▴) or the down arrow key (▾) the desired **Year** can be set. The range will be from 00 to 99.

Then when the left arrow key (◂) is pressed again the following message will be displayed.

```
 Save Settings?
Press < For Save
```

14.8 Save Settings

The relay will now ask if you would like to **Save** the changes made at various setting parameters by you.

When the left Arrow key (◂) [mode] is pressed again then the relay will **Save** the settings made and the following message will be displayed.

```
OK
```

When the left Arrow key (◂) is pressed again the relay having saved the settings made will now return to the **Main Menu** and the following message will be displayed.

→ **Date Time** ←
Measurements
Settings
Fault 1

15.0 To View the Date Time

→ **Date Time** ←
Measurement
Setting
Fault 1

By using the up arrow key (▴) or down arrow key (▾) move the arrow pointers in the display to select the **Date Time** in the main menu.

When the Right Arrow key (▸) is pressed then relay will show current time and date.

Time : 10:58:31
Tue : 13/01/09

Then when the Right Arrow key (▸) is pressed again, the relay with no other settings to be displayed will return to **main menu** to displays the following message

→ **Date Time** ←
Measurement
Setting
Fault 1

16.0 To View the Measurements

Date Time
→ **Measurement** ←
Setting
Fault 1

By using the up arrow key (▴) or down arrow key (▾) move the arrow pointers in the display to select the **Measurement** in the main menu.

Press the Right Arrow key (▸) the following values are displayed.

With Scaling
IH1= 00.00 IL1 = 00.00
IH2= 00.00 IL2 = 00.00
IH3= 00.00 IL3 = 00.00

The values displayed are that of HV and LV current of three phases respectively taking into consideration the ratio of IHM and ILM.

When the Right Arrow key (▸) is pressed then relay will show Difference Current.

Diff I	Bias I
I1D = 00.00	I1B = 00.00
I2D = 00.00	I2B = 00.00
I3D = 00.00	I3B = 00.00

The values displayed are difference in current of three phases of HV and LV respectively taking into consideration the ratio of IHM and ILM.

When the Right Arrow key (▸) is pressed then relay will show on line current without scaling.

Without Scaling
IH1= 00.00 IL1 = 00.00
IH2= 00.00 IL2 = 00.00
IH3= 00.00 IL3 = 00.00

The values displayed are that of HV and LV current of three phases respectively without taking into consideration the ratio of IHM and ILM.

When the Right Arrow key (▸) is pressed then relay will show on line current without scaling.

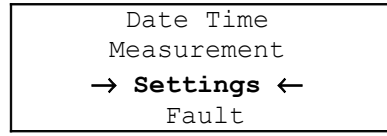
Pri.HV	Pri.LV
RH= 00000	RL= 00000
YH= 00000	YL= 00000
BH= 00000	BL= 00000

The values displayed are that of HV and LV Primary current of three phases respectively without taking into consideration the ratio of IHM and ILM.

When the Right Arrow key (▸) is pressed then relay will now displays the Main Menu as follows.

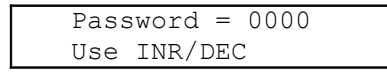
Date Time
→ **Measurement** ←
Setting
Fault 1

17.0 To Adjust Settings



By using the up arrow key (▲) or down arrow key (▼) move the arrow pointers in the display to select the **setting** in the main menu.

Now when the Left Arrow key (◄) is pressed the following message is displayed.



17.1 Password Setting

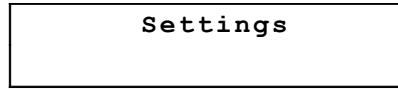
By using the up arrow key (▲) or down arrow key (▼) set the **Password** to match the previously set password.

If any of the push button is pressed for more than 4 sec. the selected value will start to increment or decrement with high speed. If up arrow key (▲) remains pressed then display value will roll between min. & max. The min. is 0 and max. is 99. If down arrow key (▼) remains pressed then display value will roll between max. & min. The max. is 99 and min. is 0.

For example if required value to be set is 25 then press up arrow key (▲) till you get reading 20, then releases the down arrow key (▼) key and increment one by one.

If the entered password matches with previously set password then we are able to enter the other settings parameters. If not the following Error message is shown on the display.

And control will automatically returned to main menu.



Note: -

In case authorized person forgets the set password, then press Left Arrow key (◄) *& 'RESET' push button* simultaneously *& release 'RESET' push button. The Relay will load default value, then release* Left Arrow key (◄) *Password will be Reset to '000' and the other settings of the relays will change to default values.*

Then when the Left Arrow key (◂) is pressed again the following message will be displayed.

```
PassWord = 001
New PassWord
```

17.2 New Password

By using the up arrow key (▴) or the arrow key (▾) ***New Password*** can be set. *(Next time when you want to change the settings in Relay Settings the new changed password to be entered then & then only it will go to next display other wise it will show the password error)*.

If the entered password matches with previously set password, and the MODE' push button is pressed the following message will be displayed.

```
Unit ID = 0001
Range 1-255
```

17.3 Unit ID Setting

By using the up arrow key (▴) or the arrow key (▾) the desired ***Unit ID*** address can be selected. The unit address will vary from 01 to 255, which means total 254 devises can be connected to single computer. The 255th address is reserved for special command. These settings are required to communicate with the SCADA computer.

Then when the left arrow key (◂) is pressed again the following message will be displayed.

```
Pickup = 0050
Range 10 - 100%
```

17.4 Pickup Setting

By using the up arrow key (▴) or the down arrow key (▾) the desired **Pickup** can be set. The setting range will be from 10% to 100% in steps of 5%. This setting is common to all three phases.

Then when the left arrow (◂) is pressed again the following message will be displayed.

```
Bias  = 0050
Range = 10% - 50%
```

17.5 Bias Setting

By using the up arrow key (▴) or the down arrow key (▾) the desired **Bias** can be set. The range will be from 10% to 50% in steps of 5%. This setting is common to all three phases

Then when the left arrow (◄) is pressed again the following message will be displayed.

```
HF  = 1200
Range 0% -2000%
```

17.6 HF Setting

By using the up arrow key (▲) or the down arrow key (▼) the desired **HF** can be set. The setting range will be from 0% to 2000% in step of 100% and 0 is equal to Bypass.

Then when the left arrow (◄) is pressed again the following message will be displayed.

```
2nd Bias I = 0400
Range 100%-400%
```

17.7 2 Bias I Setting

By using the up arrow key (▲) or the down arrow key (▼) the desired **2nd Bias I** can be set. The range will be from 100% to 400% in steps of 50%.

Then when the left arrow (◄) is pressed again the following message will be displayed.

```
CT Secondary = 1A
1A / 5A
```

17.8 CT Secondary

By using the up arrow key (▲) or the down arrow key (▼) the desired **CT Secondary** can be set. Setting can be selected, that of 1A or 5A. In which, 1A corresponds with 1Amp. and 5A correspond with 5Amp. Secondary respectively. Care should be taken to see proper connections are established at the back terminal, i.e. between Com. And 1A while selecting 1 Amp and between Com. And 5A while selecting 5Amp.

Then when the left arrow (◄) is pressed again the following message will be displayed.

```
IHM = 1.00
Range = x0.50 - x2.50
```

17.9 IHM Setting

By using the up arrow key (▲) or the down arrow key (▼) the desired **IHM** [Current Multiplier for HV Side] can be set. The setting Range is x0.50 to x2.50 in steps of 0.01.

Then when the left arrow (◂) is pressed again the following message will be displayed.

```
ILM = 1.00
Range = x0.50 –x2.50
```

17.10 ILM Setting

By using the up arrow key (▴) or the down arrow key (▾) the desired **ILM** [Current Multiplier for LV Side] can be set. The setting Range is x0.50 to x2.50 in steps of 0.01.

Then when the left arrow (◂) is pressed again the following message will be displayed.

```
Trip Test = 0002
01 : No  02 Yes
```

17.11 Trip Test

By using the up arrow key (▴) or the down arrow key (▾) the desired **Trip Test (Relay Test Selection)** setting can be selected, that of 1 or 2. When the given set value is 1 then Trip command will be bypassed (i.e Relay Test selection is disabled), but when the given set value is 2 then it will give a Trip command to the relay (i.e Relay Test selection is Enabled).

Note : This Trip Test is only for Relay Test Function (on line Testing).

Then when the left arrow (◂) is pressed again the following message will be displayed.

```
VG HV = Yy2 +60
Range = 0-13
```

17.12 VG HV Settings

By using the up arrow key (▴) or the down arrow key (▾) the desired **VG HV** [Vector Group Selection for HV Side] can be selected. The setting range is 0 to 13, in all there are 14 conditions that apply, for details refer interposing CT Selection Guide 6.1.3.

Then when the left arrow (◂) is pressed again the following message will be displayed.

```
VG LV = Yy2 +60
Range = 0-13
```

17.13 VG LV Settings

By using the up arrow key (▴) or the down arrow key (▾) the desired **VG LV** [Vector Group Selection for LV Side] can be selected. The setting range is 0 to

13, in all there are 14 conditions that apply, for details refer interposing CT Selection Guide 6.1.3.

Then when the left arrow (◄) is pressed again the following message will be displayed.

```
Baud Rate =0001
Range 1 - 6
```

17.14 Baud Rate

By using the up arrow key (▲) or the down arrow key (▼) the desired **Baud Rate** can be set. The setting range is from 1 to 6.

Set value	Baud Rate
1	*2400*
2	*4800*
3	*9600*
4	*19200*
5	*38400*
6	*57600*

Note : This feature is not available in ADR133A.

Then when the left arrow (◄) is pressed again the following message will be displayed.

```
Com Port = 0001
Range 1-2
```

17.15 Com Port

By using the up arrow key (▲) or the down arrow key (▼) the desired **Baud Rate** can be set. It can be set either 1 or 2. i.e. if given value is 1 then RS232 Port is selected and if the given value is 2 then RS 485 is selected.

Note : This feature is not available in ADR133A.

Then when the left arrow (◄) is pressed again the following message will be displayed.

```
CT Pri. HV =0010
Range 05-3000
```

17.16 CT Pri. HV

By using the up arrow key (▲) or the down arrow key (▼) the desired **CT Pri. HV** can be set. The setting range is from 05 to 3000 in steps of 01.

Then when the left arrow (◄) is pressed again the following message will be displayed.

```
CT Pri. LV =0010
Range 05-3000
```

17.17 CT Pri. LV

By using the up arrow key (▲) or the down arrow key (▼) the desired **CT Pri. LV** can be set. The setting range is from 05 to 3000 in steps of 01.

Then when the left arrow (◄) is pressed again the following message will be displayed.

```
2ND Hrm Rst. =0015
Range 0(10%)-14(80%)
```

17.18 2nd Hrm Rst.

By using the up arrow key (▲) or the down arrow key (▼) the desired **2nd Hrm. Rst.** [2nd Harmonic Restrain] can be set. The setting range is 0 to 14 in steps of 5%.

Set value	2nd Harmonic Restrain **(%)**
0	*10*
1	*15*
2	*20*
3	*25*
4	*30*

Set value	2nd Harmonic Restrain **(%)**
5	*35*
6	*40*
7	*45*
8	*50*
9	*55*

Set value	2nd Harmonic Restrain **(%)**
10	*60*
11	*65*
12	*70*
13	*75*
14	*80*

Then when the left arrow (◄) is pressed again the following message will be displayed.

```
HF NRst. = 0000
Range (1000-2000)%
```

17.19 HF NRst.

By using the up arrow key (▲) or the down arrow key (▼) the desired **HF NRst.** [HF Non Restrain] can be set. The setting range is 1000 to 2000 in steps of 500%

Then when the left arrow (◂) is pressed again the following message will be displayed.

```
HF Delay = 00.35
Range (0.1-1.0)s
```

17.20 HF Delay

By using the up arrow key (▴) or the down arrow key (▾) the desired **HF Delay** can be set. The setting range is 0.1 to 1.0 sec in steps of 0.05sec

Then when the left arrow (◂) is pressed again the following message will be displayed.

```
Save Settings?
Press < For Save
```

17.21 Save Settings

The relay will now ask if you would like to **Save** the changes made at various setting parameters by you.

Note : *In this relay all the settings are done in foreground and the relay works in background i.e. the relay will take the new settings only after completion of all settings and the confirmation by the user, then the relay will use this setting for actual operation.*

Then when the left arrow (◂) is pressed again then the relay will **save** the settings made and the following message will be displayed.

```
OK
```

Then when the left arrow (◂) is pressed again the relay having saved the settings made will now return to the **Main Menu** and the following message will be displayed.

```
Date Time
Measurement
→ Settings ←
Fault
```

18.0 To View Setting

```
      Date Time
      Measurement
  → Settings     ←
      Fault 1
```

By using the up arrow key (▲) or down arrow key (▼) move the arrow pointers in the display to select the **Settings** in the main menu.

Now when the Right Arrow key (▶) is pressed then following message is displayed

```
   Pickup = 100%
   Bias   = 050%
   HF     = 2000%
2ND Bias I = 100%
```

When the Right Arrow key (▶) is pressed again the following message is displayed.

```
CT Sec.    = 1A
IHM        = x1.00
ILM        = X1.00
Trip Test = No
```

When the Right Arrow key (▶) is pressed again the following message is displayed.

```
VG HV= Yy2 +60
VG LV= Yy2 +60
Baud Rate = NA
Com Port  = NA
```

When the Right Arrow key (▶) is pressed again the following message is displayed.

```
Pri. HV = 0010
Pri. LV = 0010
2 nd Hrm. Rst. = 015%
HF NRst. = 1000
```

When the Right Arrow key (▶) is pressed again the following message is displayed.

```
HF Delay = 00.35
```

Then when the Right Arrow key (▸) is pressed again, the relay with no other settings to be displayed will return to **main menu** to displays the following message

```
      Date Time
      Measurement
  → Settings     ←
      Fault 1
```

19.0 To View FAULT 1

```
      Date Time
      Measurement
      Setting
  → Fault 1      ←
```

By using the up arrow key (▴) or down arrow key (▾) move the arrow pointers in the display to select the **Fault 1** in the main menu.

Now When the Right Arrow key (▸) is pressed then following message is displayed.

```
Bias : T   TC : 0153
HF :
Date : 28/11/08
Time : 11:49:52:060
```

Explanation:

First line define the **Type of Bias Fault** & **Trip Counter**

Second line define **HF Fault**

Third line defines the **Date**

Forth line defines **Time of fault**.

When the Right Arrow key (▸) is pressed then following message is displayed.

```
        Fault Value
IH1 = 00.00    IL1 = 00.00
IH2 = 00.00    IL2 = 00.00
IH3 = 00.00    IL3 = 00.00
```

Explanation:

First line defines the HV Current & LV Current for **R Phase** respectively at the time of the fault.

Second line defines the HV Current & LV Current for **Y Phase** respectively at the time of the fault.

Third line defines the HV Current & LV Current for **B Phase** respectively at the time of the fault.

When the Right Arrow key (▸) is pressed then following message is displayed.

```
Diff I         Bias I
I1D = 00.00    I1B = 00.00
I2D = 00.00    I2B = 00.00
I3D = 00.00    I3B = 00.00
```

Explanation :

First line defines difference current of the HV Current & LV Current for **R Phase** respectively at the time of the fault.

Second line defines difference current of the HV Current & LV Current for **Y Phase** respectively at the time of the fault.

Third line defines difference current of the HV Current & LV Current for **B Phase** respectively at the time of the fault.

```
          HV Vector
r1 = +0.000   i1 = +0.000
r2 = +0.000   i2 = +0.000
r3 = +0.000   i3 = +0.000
```

Explanation :

First line defines real and imaginary vector components for **R Phase HV side** respectively at the time of the fault.

Second line defines real and imaginary vector components for **Y Phase HV side** respectively at the time of the fault.

Third line defines real and imaginary vector components for **B Phase HV side** respectively at the time of the fault.

```
        LV Vector
r1 = +0.000  i1 = +0.000
r2 = +0.000  i2 = +0.000
r3 = +0.000  i3 = +0.000
```

Explanation :

First line defines real and imaginary vector components of **R Phase LV side** respectively at the time of the fault.

Second line defines real and imaginary vector components of **Y Phase LV side** respectively at the time of the fault.

Third line defines real and imaginary vector components of **B Phase LV side** respectively at the time of the fault.

```
        HV  2nd Hrm
r1 = +0.000  i1 = +0.000
r2 = +0.000  i2 = +0.000
r3 = +0.000  i3 = +0.000
```

Explanation :

First line defines real and imaginary vector components of **2nd Harmonic R Phase HV Side** respectively at the time of the fault.

Second line defines real and imaginary vector components of **2nd Harmonic Y Phase HV Side** respectively at the time of the fault.

Third line defines real and imaginary vector components of **2nd Harmonic B Phase HV Side** respectively at the time of the fault.

```
        LV  2nd Hrm
r1 = +0.000  i1 = +0.000
r2 = +0.000  i2 = +0.000
r3 = +0.000  i3 = +0.000
```

Explanation :

First line defines real and imaginary vector components of **2nd Harmonic R Phase LV Side** respectively at the time of the fault.

Second line defines real and imaginary vector components of **2nd Harmonic Y Phase LV Side** respectively at the time of the fault.

Third line defines real and imaginary vector components of **2nd Harmonic B Phase LV Side** respectively at the time of the fault.

Then when the Right Arrow key (▸) is pressed again, the relay with no other settings to be displayed will return to **main menu** to displays the following message

```
      Date Time
      Measurement
      Setting
  → Fault 1      ←
```

To View (FAULT 2) (FAULT 3) (FAULT 4) and (FAULT 5) : - follow steps as given above.

20.0 Relay Test

```
      Fault 3
      Fault 4
      Fault 5
  → Relay Test  ←
```

By using the up arrow key (▴) or down arrow key (▾) move the arrow pointers in the display to select the **Relay Test** in the main menu.

When the Right Arrow key (▸) is pressed the Relay will provide TRIP command and fault is recorded.

```
Bias : T    TC : 0253
HF   : 000
Date : 06/07/07
Time : 11:49:52:060
```

When the Right Arrow key (▸) is pressed then following message is displayed

```
       Fault Value
IH1 = 00.00 IL1 = 00.00
IH2 = 00.00 IL2 = 00.00
IH3 = 00.00 IL3 = 00.00
```

When the Right Arrow key (▸) is pressed then following message is displayed

```
Diff I        Bias I
I1D = 00.00   I1B = 00.00
I2D = 00.00   I2B = 00.00
I3D = 00.00   I3B = 00.00
```

When the Right Arrow key (▸) is pressed then following message is displayed

```
        HV Vector
r1 = +0.000  i1 = +0.000
r2 = +0.000  i2 = +0.000
r3 = +0.000  i3 = +0.000
```

When the Right Arrow key (▸) is pressed then following message is displayed

```
        LV Vector
r1 = +0.000  i1 = +0.000
r2 = +0.000  i2 = +0.000
r3 = +0.000  i3 = +0.000
```

When the Right Arrow key (▸) is pressed then following message is displayed

```
        HV 2nd Hrm
r1 = +0.000  i1 = +0.000
r2 = +0.000  i2 = +0.000
r3 = +0.000  i3 = +0.000
```

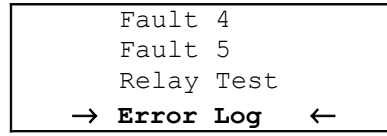
When the Right Arrow key (▸) is pressed then following message is displayed

```
        LV 2nd Hrm
r1 = +0.000  i1 = +0.000
r2 = +0.000  i2 = +0.000
r3 = +0.000  i3 = +0.000
```

Then when the Right Arrow key (▸) is pressed again, the relay with no other settings to be displayed will return to **main menu** to displays the following message

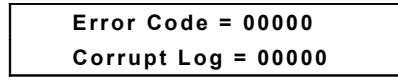
```
      Date & Time
      Measurement
      Settings
   → Fault 1  ←
```

21.0 To View Error Log



By using the up arrow key (▲) or down arrow key (▼) move the arrow pointers in the display to select the **Error Log** in the main menu.

When the Right Arrow key (▶) is pressed again then following message is displayed.

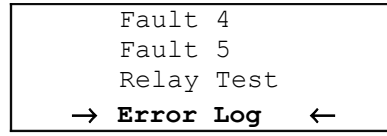


The relay continuously keeps track on its internal hardware and the moment it detects any failure of component, a message is displayed on LCD display. The type of error can be checked by "*Error Log"* menu. This feature is very useful for giving pre information to avoid mal operation.

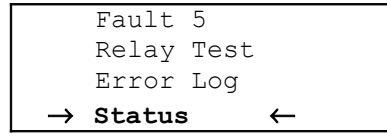
Following are some of Error codes: -

Error Code	Description
0001	Setting Error
0002	EPP Error
0004	RTC Error
0008	External Crystal connected to Timer 1 of microcontroller
0016	FRAM 1 Error
0032	FRAM 2 Error

Then when the Right Arrow key (▶) is pressed again, the relay with no other settings to be displayed will return to **main menu** to displays the following message

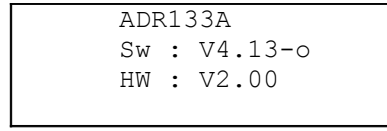


22.0 To View Status

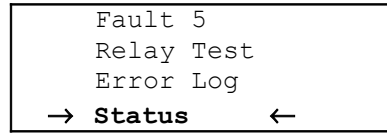


By using the up arrow key (▲) or down arrow key (▼) move the arrow pointers in the display to select the **Status** in the main menu.

When the Right Arrow key (▶) is pressed again then following message is displayed.



Then when the Right Arrow key (▶) is pressed again, the relay with no other settings to be displayed will return to **main menu** to displays the following message

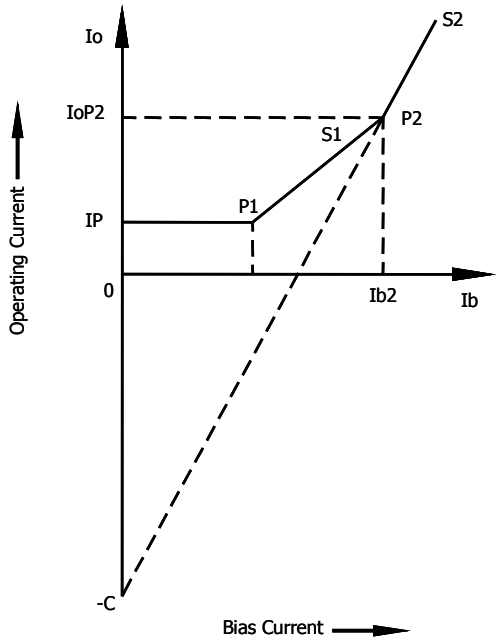


23.0 Lab Verification Of Relay Characteristics

Relay Function :

The operating characteristics can be easily verified during table testing.

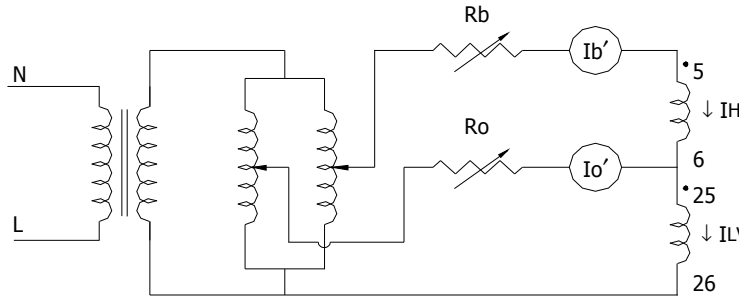
The relay operating characteristics is as shown in figure.



When Ib is less than Ib2 relay follow set bias (S1)

When Ib ≥ Ib2 Relay follow fix bias of 80% (S2)

The figure shows typical test setup.



Here Relay measure HV & LV current.

IHV = Ib′ & ILV = Ib′ + Io′

Relay calculate base (Ib) & operating current (Io)

$$Ib = \left| \frac{IHV+ILV}{2} \right|$$

$$= \left| \frac{Ib' + Ib' + Io'}{2} \right|$$

$$= \left| \frac{2\,Ib' + Io'}{2} \right|$$

$$Ib = Ib' + 0.5\,Io' \text{ ----------}\{1\}$$

$$Io = \left| IHV - ILV \right|$$

$$= \left| Ib' - (Ib' + Io') \right|$$

$$= \left| Ib' - Ib' - Io' \right|$$

$$= \left| - Io' \right|$$

$$= Io' \text{ ----------}\{2\}$$

CASE 1 : When Ib< Ib2

Relay provide trip command when

Io = S1 x Ib (where S1 = set bias)

$$S1 = \frac{Io}{Ib}$$

$$\mathbf{S1 = \frac{Io'}{Ib' + 0.5\ Io'}} \quad \text{----------{3}}$$

CASE 2 : When Ib ≥ Ib2

When Ib < Ib2 relay follows straight line equation.

Io = S1 x Ib

The position of point P2 is at the end of first slope line, the Io current at this point will be

Iop2 = S1 x Ib2 ----------{4}

The Point P2 is also starting point of Slop 2.

When Ib > Ib2 relay follows straight line equation

Io = S2 x Ib + C, Where C is constant and S2 = 0.8

Thus

Iop2 = S2 x Ib2 + C ----------{5}

Therefore from 4 & 5

S1 x Ib2 = S2 x Ib2 + C

Therefore C = S1 x Ib2 – S2 x Ib2

= (S1 – S2) x Ib2

= (S1 – 0.8) x Ib2 ---------- {6}

Io = S2 x Ib + C

$$S2 = \frac{Io - C}{Ib}$$

Thus 2nd Bias (i.e. 80%) can be verified from following formula

From Equation 1 & 2

$$\mathbf{S2 = \frac{Io' - C}{Ib' + 0.5 \times Io'}} \quad \text{---------- {7}}$$

From Equation 3 & 7 we can verify Relay characteristics

24.0 Complete Functional Testing

Using following procedure all the main characteristic of relay can be checked.

Test equipment required: -

1. Variable Voltage Transformer (variac)
2. Digital Timer
3. D.C power supply.
4. Current Meter 0-10A - 2 nos.
5. Double pole switch – 2 nos.
6. 0 - 100 Ohms variable resistor of suitable rating - 2 nos.
7. Diode rated 7 Amp/500V PIV for simulation magnetising inrush current.
8. Digital Multimeter

Auxiliary Supply: -

The relay is available for two different types of auxiliary supply 1) for 18V to 52VDC and 2) for 77V to 252VDC. Check the relay rated auxiliary voltage on the front panel and connect a suitable D.C supply or station battery supply to relay terminal 15 and 16. If DC supply is not available the AC voltage of 110V can be used for relay having auxiliary supply voltage range 77 to 252VDC.

After connecting auxiliary supply switch on the Power supply and the check the power on indication provided on relay front. The relay will display following message

```
Ashida Numerical
Tx. Diff. Relay
ADR 133A V4.13-o
Unit ID = 0001
```

```
With Scaling
IH1= 00.00 IL1 = 00.00
IH2= 00.00 IL2 = 00.00
IH3= 00.00 IL3 = 00.00
```

25.0 Drawing for pickup Time & HF Testing

26.0 Testing of Relay

26.1 Relay Calibration

Before conducting actual test confirm relay calibration by following method

1. Connect ADR 133A relay to current injector and timer as shown in diagram above.

2. Connect terminals as per the table given below

		Model AM00101 AM00102	**Model** Am00104	**Model** Am00105	**Model** Am00205	
		Non Drawout	Drawout	Non Drawout	Non Drawout	
			CT selectable		CT selectable	
Phase			**1A**	**5A**	**1A**	**5A**
R	HV	5, 6	6,7	6,8	7, 8	7, 9
R	LV	25, 26	15,16	15,17	16, 17	16,18
Y	HV	7, 8	21, 22	21, 23	21, 22	21, 23
Y	LV	27, 28	30, 31	30, 32	30, 31	30, 32
B	HV	9, 10	25, 26	25, 27	25, 26	25, 27
B	LV	29, 30	34, 35	34, 36	34, 35	34, 36

3. Adjust rated CT Secondary Current 1A/5A. Observe the current value from measurement menu (without Scaling). The actual current should match with relay display

4. Adjust trimpot if it shows difference in actual and standard source. Refer following table for calibration.

Phase	Trimpot
RHV	P2
RLV	P3
YHV	P4
YLV	P5
BHV	P6
BLV	P7

26.2 Pickup Test

1. Connect ADR 133A relay to current injector and timer as shown in diagram.

2. Select Pickup = 10%, Bias = 20%.

3. Switch on current injector and inject the current to relay

4. Now start increasing the current using VI control (Variac) and observe the pickup indication of the relay.

5. When the injected current crosses Pickup % relay Pickup led will glow indicating relay pick-up condition. The relay gives trip signal. Note down this current value as pick value of relay.

6. At the same time the relay latches the fault in the current buffer.

7. Read that current fault and note down the trip current value.

8. Repeat the procedure for different pickup setting for different phases as per test report.

Pick-up Test (IN AMPS.)
(Allowed Tolerance ± 10%)

Operating Current Setting	R Phase				Y Phase				B Phase			
	1Amp.		5Amp.		1Amp.		5Amp.		1Amp.		5Amp.	
	IH1	IL1	IH1	IL1	IH2	IL2	IH2	IL2	IH3	IL3	IH3	IL3
10%												
30%												
50%												

Result : Pickup accuracy was found within _____

26.3 Time Test

1. Set Pickup = 10%.

2. Connect trip contacts (1 and 2) to stop terminals of Timer

3. Adjust current twice the pickup setting as per test report.

4. Reset the Timer.

5. Start the timer using start push button. The timer will stop automatically when relay gives trip command.

6. Note down the time value.

7. Repeat the procedure for different phases as per test report.

Operating Time Test (in milli seconds)
(Allowed Tolerance < 40msec.)

Note: Inject current 2 times of operating current setting.

R	T =
Y	T =
B	T =

26.4 HF Test

1. Set pickup = 10%. Set HF = 100%.

2. Start increasing the current using variac when it crosses HF % settings the relay gives trip signal and the timer will stop.

3. The unit latches the fault current and will display message as follows

```
Bias : B      TC : 0153
HF : B
Date : 06/07/07
Time : 11:49:52:060
```

```
IH1 = 00.00    IL1 = 00.00
IH2 = 00.00    IL2 = 00.00
IH3 = 00.00    IL3 =  1.44
```

```
Diff I         Bias I
I1D = 00.00    I1B = 00.00
I2D = 00.00    I2B = 00.00
I3D = 00.00    I3B = 00.00
```

4. Note down the current value.

5. Repeat the procedure for different setting as per test report.

H.F. Test : [1Amp.]

H.F. %	100	200	300	400	600	800	1000	1200	1400	1600	1800	2000
R												
Y												
B												

26.5 Drawing of Bias Test

Bias Test

1. Set pickup = 10%. Set HF = 100%.
2. Adjust Bias current = 1.5Amp. by adjusting resistance RB.
3. Slowly increase the differential current Io by decreasing the resistor Ro until the relay operates as indicated by the front plate LED.

For Phase R (1Amp.)

Set Biased	Ib′ Amp.	Io′ Amp.	Expected Io′
10 %	1.5		0.16 to 0.19
30 %	1.5		0.49 to 0.57
50 %	1.5		0.95 to 1.05

For Phase R (5Amp.)

Set Biased	Ib′ Amp.	Io′ Amp.	Expected Io′
10 %	6		0.50 to 0.76
30 %	6		1.16 to 2.28
50 %	6		3.79 to 4.21

For Phase Y (1Amp.)

Set Biased	Ib′ Amp.	Io′ Amp.	Expected Io′
10 %	1.5		0.16 to 0.19
30 %	1.5		0.49 to 0.57
50 %	1.5		0.95 to 1.05

For Phase Y (5Amp.)

Set Biased	Ib′ Amp.	Io′ Amp.	Expected Io′
10 %	6		0.50 to 0.76
30 %	6		1.16 to 2.28
50 %	6		3.79 to 4.21

For Phase B (1Amp.)

Set Biased	Ib′ Amp.	Io′ Amp.	Expected Io′
10 %	1.5		0.16 to 0.19
30 %	1.5		0.49 to 0.57
50 %	1.5		0.95 to 1.05

For Phase B (5Amp.)

Set Biased	Ib′ Amp.	Io′ Amp.	Expected Io′
10 %	6		0.50 to 0.76
30 %	6		1.16 to 2.28
50 %	6		3.79 to 4.21

Result : Io´ should be within expected Io´ value

4. The Bias Slop on which the relay operates can be calculated by the following formula

$$\text{Percentage Bias} = \frac{100x(Io')}{(Ib')+0.5(Io')}$$

The observed Bias should be ±2% of set Bias. I.e. for 10% setting observed Bias should be within 8% to 12%

5. Example

Relay setting
Set PKP = 10%
Set Bias = 10%
2nd Bias I = 200%
CT Secondary = 1Amp.
Apply Ib′ = 1.5Amp.
The following result is observed
Io′ = 0.18Amp.
Then relay Bias can be calculated as follows

$$\text{Percentage Bias} = \frac{100x\ (Io')}{(Ib')+0.5(Io')}$$

$$= \frac{100 \times 0.18}{1.5 + (0.5 \times 0.18)}$$

$$= \frac{18}{1.59}$$

$$= 11.32$$

6. Repeat the procedure for different setting as per test report.

Second Bias Test

1. Set Pickup = 10% Set HF = 1200
2. Second Bias = 200%

3. Adjust Bias Current Ib = 2A for 1A Secondary. (10A. for 5A Secondary)

4. Slowly increase the differential current Io by decreasing the resistor Ro until the relay operates as indicated by the front plate LED.

For Phase R (1Amp.)

Set Biased	Ib′ Amp.	Io′ Amp.	Expected Io′
10 %	2		0.23 to 0.44
30 %	2		0.88 to 1.13
50 %	2		1.53 to 1.8

For Phase R (5Amp.)

Set Biased	Ib′ Amp.	Io′ Amp.	Expected Io′
10 %	10		1.20 to 2.20
30 %	10		4.45 to 5.60
50 %	10		7.66 to 9.05

For Phase Y (1Amp.)

Set Biased	Ib′ Amp.	Io′ Amp.	Expected Io′
10 %	2		0.23 to 0.44
30 %	2		0.88 to 1.13
50 %	2		1.53 to 1.8

For Phase Y (5Amp.)

Set Biased	Ib′ Amp.	Io′ Amp.	Expected Io′
10 %	10		1.20 to 2.20
30 %	10		4.45 to 5.60
50 %	10		7.66 to 9.05

For Phase B (1Amp.)

Set Biased	Ib′ Amp.	Io′ Amp.	Expected Io′
10 %	2		0.23 to 0.44
30 %	2		0.88 to 1.13
50 %	2		1.53 to 1.8

For Phase B (5Amp.)

Set Biased	Ib′ Amp.	Io′ Amp.	Expected Io′
10 %	10		1.20 to 2.20
30 %	10		4.45 to 5.60
50 %	10		7.66 to 9.05

5. The Second Bias Slop on which the relay operates can be calculated by the following formula

Note : If Ib > Ib2 then use second Bias formula.

$$\text{Second Bias} = \frac{(Io' - C)}{(Ib' + 0.5Io')} \times 100$$

Where

C = (S1 – 0.8) x Ib2

S1 = Set Bias (10% - 50%)

S2 = Fixed Bias (80%)

Ib2 = Second Bias (100% - 400%)

The observed Bias should be ± 3% of set Bias. I.e. for 10% setting observed Bias should be within 77% to 83%

6. Example for calculation of Second Bias

Set Pickup = 10%
Set Bias = 10%
Second Bias = 200%
Ib′= 2Amp. Io′ = 0.35

$$S2 = \frac{(Io' - C)}{(Ib' + 0.5Io')} \times 100$$

C = (S1 – 0.8) x Ib2

If CT Seconday is 1amp.

Then S1 = 0.1 (10% of CT Secondary i.e. 1Amp.)

S2 = 0.8

Ib2 = 2Amp. (200% of CT Secondary i.e. 1Amp)

C = (S1 – 0.8) x Ib2
= (0.1-0.8) x 2
= (- 0.7) x 2
= -1.4

$$S2 = \frac{(Io' - C)}{(Ib' + 0.5Io')} \times 100$$

$$= \frac{0.35-(-1.4) \times 100}{2 + (0.5 \times 0.35)}$$

$$= \frac{0.35 + 1.4 \times 100}{2 + 0.175}$$

$$= \frac{1.75 \times 100}{2.175}$$

$$= 80..45$$

Note : Value of C will change for different S1 & Ib2 Settings.

26.6 Drawing of Magnetic inrush Test

Magnetic Inrush Test

1. The relay may be tested with a simulated wave form representing magnetizing inrush by connecting a diode in series with the relay to produce a half wave rectified wave.
2. With reference to fig.4, close switch S1 and S2 and set the current to equal to rated of relay Check that the relay operates.
3. Open switch S2, close switch S1 and check that the relay does not operate.
4. If is preferred to test the relay with the magnetising current of the transformer, it is suggested that the transformer energised ten times at full rated voltage on load and check that the relay does not mall-operate.

26.7 Post installation Test

1. After installation of relay and put it in service. Confirm all CT connections.
2. Also check the trip circuit connections.

27.0 Technical Specifications

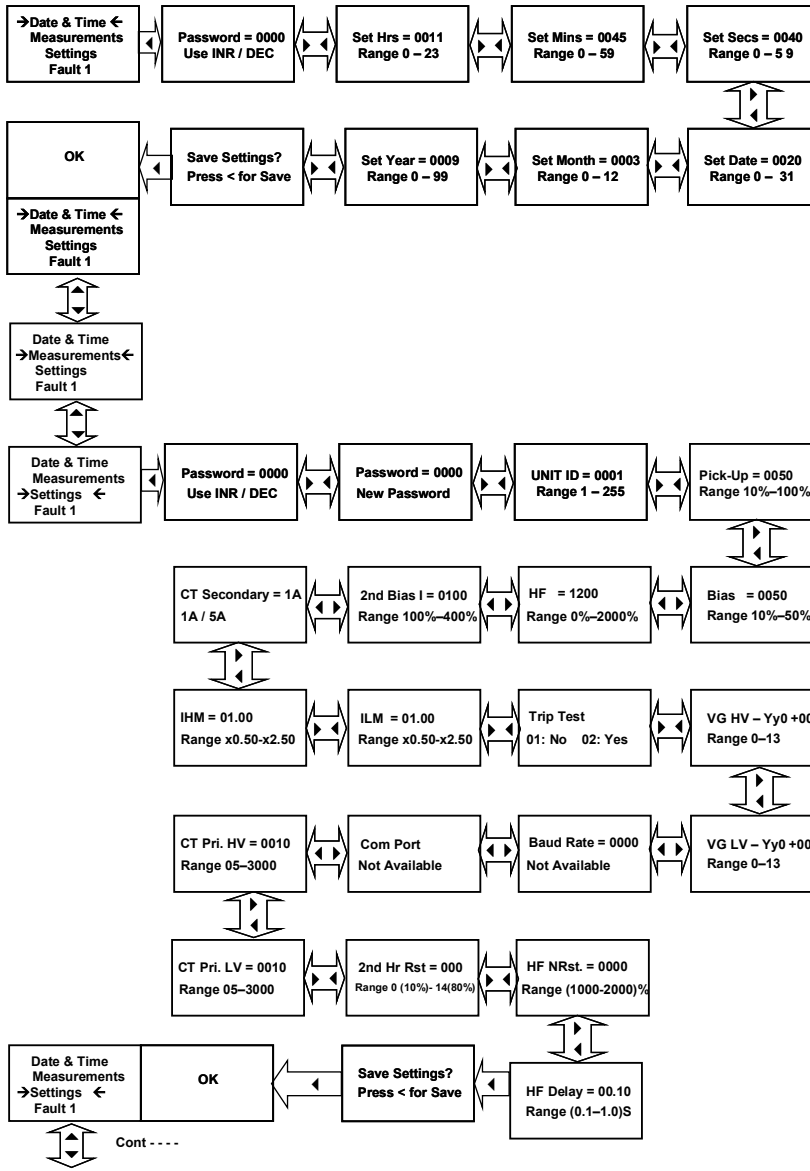
Sr. No.	Specification	Particulars
I.	Aux. Supply	: 18 – 52VDC, 77 – 250VDC 18 – 250 VDC. To be specified while ordering.
II.	CT Inputs	: Suitable for CT secondary 1Amp., 5Amp., 1 Amp. / 5 Amp. selectable.
III.	Operating Current	: 10% - 100% adjustable. In steps of 5%
IV.	Bias	: Bias setting is adjustable by switch at: 10 - 50%. In steps of 5%
V.	2nd Harmonics Restrain	: 10% to 80% settable
VI.	High Set setting	: 100% to 2000% in steps of 100%
VII.	Vector group compensation for HV winding	: VH:- Yy0, Yy2, Yy4, Yy6, Yy8, Yy10, Yd1, Yd3, Yd5, Yd7, Yd9, Yd11, Ydy0 and Ydy6
VIII.	Vector group compensation for LV winding	: VL:- Yy0, Yy2, Yy4, Yy6, Yy8, Yy10, Yd1, Yd3, Yd5, Yd7, Yd9, Yd11, Ydy0 and Ydy6
IX.	Output Contact	: 2NO for Trip : 1NO for Relay Operated : 1NO for Relay Faulty : 1NO for HF(Instantaneous) Operated
X.	Operational Indicators (Flags)	: Green LED indicates Power ON : Red LED indicates Relay Pickup Self Reset (SR) type. : Red LED indicates Fault condition Hand Reset (HR) type. : Green LED indicates output close relay contact closer. Programmable as HR or SR
XI.	Operating time	: Less then 30ms at 5 Times of rated
XII.	Burden on CTs	: Less than 0.2VA.
XIII.	Burden on Aux. Supply	: Less than 10VA on any supply.
XIV.	Control Contacts	: 2 NO contacts (SR) self reset are given for Trip & Annunciation. - Trip Duty [Model : Am00101 & Am00102] : 3 NO contacts (SR) self reset are given 2 for Trip & 1 for Annunciation [Model : Am00104 & Am00105] : 5 NO contacts (SR) self reset are given 2 for Trip, 1 for Annunciation, 1 for Relay OK & 1 for High Fault [Model : Am00205]

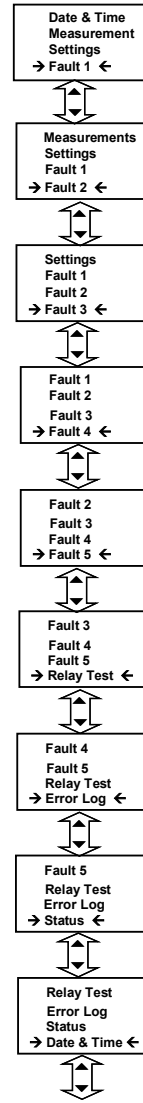
XV.	Contact Rating for Trip Contract	: Make and carry for continuous – 5A : Make and carry for 0.5 sec. – 30A : Make and Carry for 3 sec . – 15A
XVI.	Thermal Withstand Capacity	: x40 times the normal current for 3sec. : x2 Continuous
XVII.	High Voltage Test	: IEC 60255-5 : Except DC Voltage – 2.0 kV (RMS), 50Hz : Only DC voltage - 2.8 kV DC : Between Open contact of TRIP / CLOSE 1.5kV (RSM) 50Hz : Between Open contact of ALARM – 1kV (RSM) 50Hz
XVIII.	Shock Test	: IEC 60255-21-2 class 1 : Semi-Sinusoidal : 5g acceleration, duration 11ms, : Each 3 shocks in both direction of the 3 axes
XIX.	High Frequency Disturbance test	: IEC 60255-22-1 & IEC 61000-4-12 :2001 : Common Mode : 2.5Kv ; 3 Pulses for 2 Seconds : Differential Mode :1.0Kv ;3 Pulses for 2 Seconds
XX.	Power Frequency Magnetic Field	: As per IEC 61000-4-8,2001 : Magnetic Field 100 A/M for 1 Minute & 1000 A/m for 3 Sec
XXI.	Surge	: As per IEC 60255-22-2 & IEC 61000-4-5,2005 : Pulse – 1.2 / 50μ : Pulse Amplitude – Common Mode : 2Kv Differential Mode : 1Kv
XXII.	Radiated Susceptibility	: As per IEC 60255-22-3 & IEC 61000-4-3 :2006 : Frequency range – 80Mz to 1000 MHz : Modulation -- 80% AM@ 1kHz : Field Strength 10V/m
XXIII.	Electrostatic Discharge	: As per IEC 60255-22-2 & IEC 61000-4-2 :2002 : Air Discharge of 8kV on non-conductive surfaces : Contact Discharge of 6kV on Conductive surfaces
XXIV.	Electrical Fast Transients (Burst)	: As per IEC 60255-22-4 & IEC 61000-4-4:2004 : In Differential mode 4kV for 60 s : in common mode 4kV for 60 s
XXV.	Conducted Emission	: As per CISPR 11.2004 : Measurement range for 150 kHz – 30 MHz
XXVI.	Radiated Emission	: As per CISPR 11:2004 : Measurement Range for 30 – 1000 MHz

XXVII.	Conducted RF Susceptibility	: As per IEC 60255-22-6 & IEC 61000-4-6,2006 : Frequency range : 150Khz – 80 MHz	
XXVIII.	Vibration Test	: IEC 60255-21-1 class 1 / IEC 60068-2-6 : Sinusoidal 10 to 60Hz ±0.035 mm : Amplitude, 60 to 150Hz, 0.5g acceleration : Sweep rate 1 octave/min; 20 cycle in 3 orthogonal	
XXIX.	Drawing Reference	: For Cabinet Type	CSD-V-120 (MAC00402)
		: For Electrical Connection (Model : Am00101 & Am00102)	ACD01401
		: For Back Terminal Arrangement (Model : Am00101 & Am00102)	ACD01501
		: For Electrical connection (Drawout) (Model : Am00104 & Am00105)	ACD01601
		: For Back Terminal Arrangement (Drawout) (Model : Am00104 & Am00105)	ACD01701
		: For Electrical connection (Non-Drawout) (Model : Am00205)	ACD01602
		: For Back Terminal Arrangement (Non-Drawout) (Model : Am00205)	ACD01703
		: For Block Diagram	ACD01603

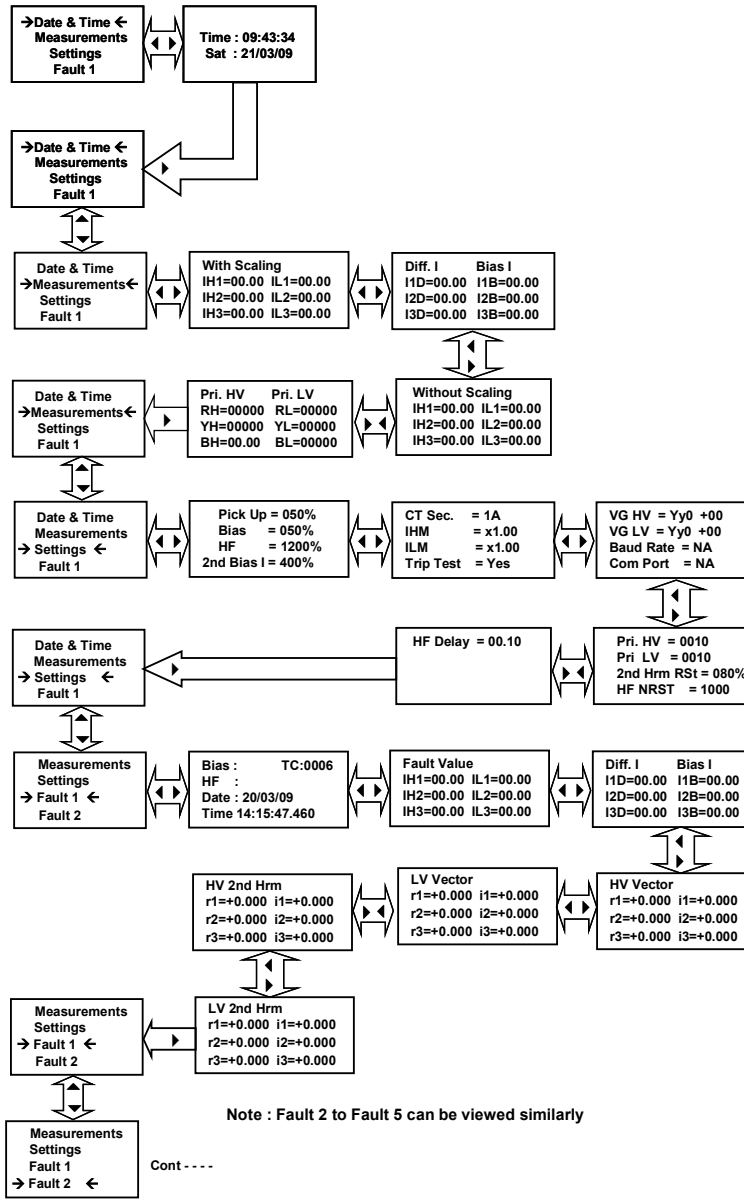
28.0 FLOW CHART

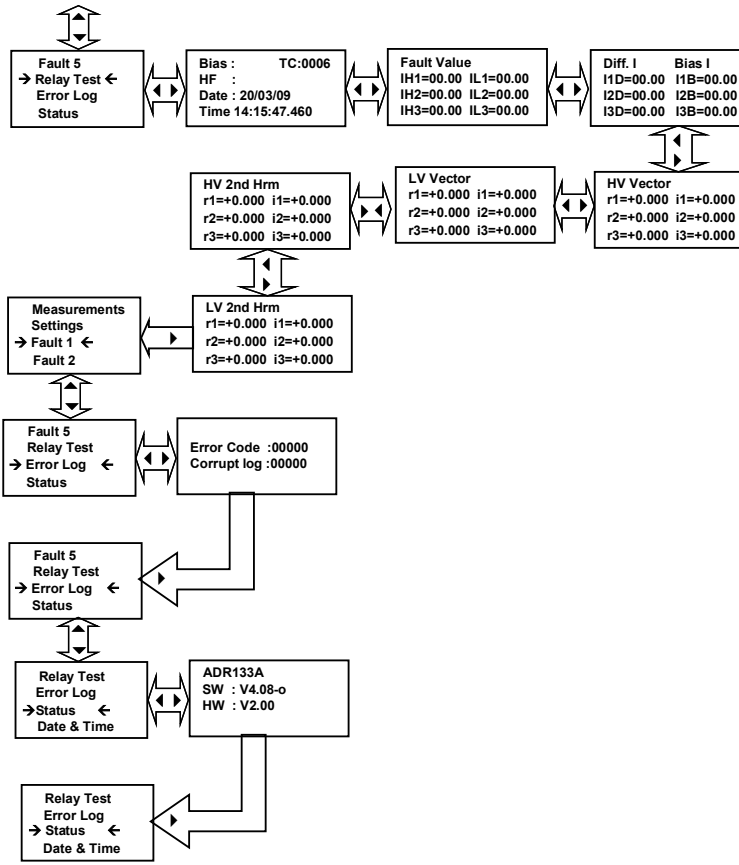
28.1 FLOW CHART FOR SETTING




Date & Time
Measurement
Settings
→ Fault 1 ←
Measurements
Settings
Fault 1
→ Fault 2 ←
Settings
Fault 1
Fault 2
→ Fault 3 ←
Fault 1
Fault 2
Fault 3
→ Fault 4 ←
Fault 2
Fault 3
Fault 4
→ Fault 5 ←
Fault 3
Fault 4
Fault 5
→ Relay Test ←
Fault 4
Fault 5
Relay Test
→ Error Log ←
Fault 5
Relay Test
Error Log
→ Status ←
Relay Test
Error Log
Status
→ Date & Time ←

28.2 FLOW CHART TO VIEW SETTING




Fault 5
→ Relay Test ←
Error Log
Status
Bias : TC:0006
HF :
Date : 20/03/09
Time 14:15:47.460
Fault Value
IH1=00.00 IL1=00.00
IH2=00.00 IL2=00.00
IH3=00.00 IL3=00.00
Diff. I Bias I
I1D=00.00 I1B=00.00
I2D=00.00 I2B=00.00
I3D=00.00 I3B=00.00
HV 2nd Hrm
r1=+0.000 i1=+0.000
r2=+0.000 i2=+0.000
r3=+0.000 i3=+0.000
LV Vector
r1=+0.000 i1=+0.000
r2=+0.000 i2=+0.000
r3=+0.000 i3=+0.000
HV Vector
r1=+0.000 i1=+0.000
r2=+0.000 i2=+0.000
r3=+0.000 i3=+0.000
Measurements
Settings
→ Fault 1 ←
Fault 2
LV 2nd Hrm
r1=+0.000 i1=+0.000
r2=+0.000 i2=+0.000
r3=+0.000 i3=+0.000
Fault 5
Relay Test
→ Error Log ←
Status
Error Code :00000
Corrupt log :00000
Fault 5
Relay Test
→ Error Log ←
Status
Relay Test
Error Log
→Status ←
Date & Time
ADR133A
SW : V4.08-o
HW : V2.00
Relay Test
Error Log
→ Status ←
Date & Time

29.0 Typical Electrical Connection

30.0 Back Terminal Connection

31.0 Typical Electrical Connection

32.0 Back Terminal Connection

33.0 Typical Electrical Connection

34.0 Back Terminal Connection

35.0 Block Diagram

36.0 Mechanical Details

37.0 Revision Notes

Revision no.	*Date*	*Revision Note*
01	19.02.07	Original
02	02.07.07	ADR233A Added, Testing Procedure Revised
03A	20.03.09	Software Revision 4.08
03B	08.10.09	Software Revision 4.13